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A NOVEL WCMFO-PTS OPTIMIZATION TECHNIQUE FOR REDUCING PAPR IN OFDM SYSTEMS

Isha Goel
Department of ECE, Rayat Bahra University, Mohali

Mandeep Kaur
Department of ECE, Rayat Bahra University, Mohali

Himanshu Monga
Department of ECE, Jawaharlal Nehru Government Engineering College, HP,
ishagoel565@gmail.com.

Abstract:
With the advantage of increased compatibility, OFDM high-speed mobile networks will be a key modulation technique within the next generations. Also, due to the general scarcity of available bandwidth, the need for high-speed applications is growing. As techniques are commonly developed, the use of both wired and moreover wireless technologies is increasing. As a response, high data rates are required, as well as the number of input increases. The PAPR is affected as a result. The main challenge with this type of OFDM is to improve system efficiency by lowering PAPR. Numerous reduction techniques, such as SLM, PTS and clipping, are accessible in the research industry. For enhanced findings, the study paper uses a modified PTS approach that incorporates a phase factor and optimization algorithm. This optimization is superior to nature-inspired methods in terms of data categorization complexity and speed of convergence. So when the results of the experiments are compared, this is discovered that our proposed WCMFO-PTS optimization technique outperforms the conventional optimization methods.
Keywords: OFDM, WCMFO-PTS, PAPR, etc.

INTRODUCTION

OFDM is a digital modulation method used during wireless technology. As a result, the OFDM approach is widely employed for maximum signal transfer in frequency-selective fading systems [1,2]. Due to their multi-carrier structure, OFDM transmissions typically contain time, frequency amplitude fluctuation and a large array of dynamic, which is known to as PAPR[1].

A message will pass via a high power amplifiers (HPA) in a typical Modulation scheme, which really is nonlinear and has a high PAPR. The data will be trimmed as a result of the challenges, which will lead to further issues such as output degeneration, out-of-band irradiation, and in-band deformation, all of which must be rectified to excellent results[2]. Clip, non-linear companding, coding, tone

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About the authors：Isha Goel
Corresponding author- *Email:

reservation and injection, selective mapping (SLM), and final partial transmit sequence (PTS), among other approaches, is utilized in Ofdm signal to solve the problem [3].
There seem to be distinct sub-blocks in the PTS methodology, and every one of these will use IFFT methods to convert the information and thereafter multiply this by a phase rotational factor. This approach also improves the signal's PAPR to a certain extent by selecting phase variables and signals sub-blocks [3]. The search difficulty of the PTS approach increases exponentially as the number of inputs and their phase rotational factors grows. As a result, different inadequate PTS approaches [4–6] have been explored in prior studies to lessen retrieval complexity.
This work proposes a novel strategy to handle the PAPR as well as computational complexity diminish issues connected with the PTS method. The strategy centred on combining water-cycle optimization (WCO) with moth-flame optimization (MFO) to form WCMFO-PTS. The random variable of the Water Cycle Technique increases exploring capabilities in the WCMFO-PTS algorithm, which also conclude improved exploited capability via the Moth - Flame Individual's moth generated spiral movement. The randomness was also improved in the novel process by altering the positions and stream.
The rest of this study is organized as follows: in Section II, we go over the relevant literature regarding OFDM and PAPR values. In section III, we present our suggested technique and afterwards examine its overall performance of PAPR & complexity with greater potential performance in section IV. In Sections III and IV, also present the general implementation of the suggested method in the format of algorithms, examine their computational burden in depth using simulation results, and evaluate these results while evaluating the proposed method to different methods from relevant literature. Lastly, in Section V, we make our findings.

OFDM AND PAPR VALUE

Assume an OFDM network with N sub-carriers and symbol translation. While X[k], k=0,1,….,N-1 is the vectors of mapped information bits, the repetitions of the baseline time series x[i], i==0,1,…., N-1 produced at the end of the IFFT block were represented as:

$$\boldsymbol{x[i] \cong \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X(k) exp\left(j \frac{2\pi}{N} ki\right)} \quad (1)$$

The PAPR of a baseband signal x[i] is defined as follows:

$$\boldsymbol{p_x := \frac{\underset{i}{max}\{|x[i]|^2\}}{p_x}} \quad (2)$$

With $\mathbf{max}\{|\boldsymbol{x[i]}|^2\}$ is the highest output sub-carrier energy throughout the OFDM signal and $\boldsymbol{p_x = \frac{1}{\sqrt{N}} \sum_{i=0}^{N-1} |x[i]|^2}$ is the mean simultaneous sub-carrier power inside the OFDM symbol.

There are two primary groups of PAPR reduction strategies, the first is the use of distortions procedures before the IFFT phase. After the IFFT phase, signal distorting methods are used. Any

PAPR method involves trade-offs between a number of key performance measures, including PAPR and computational complexity. Finally, we'll look at the economic that come with the most well-known of those methods.

PROPOSED WORK

The WCMFO-PTS is a soft computing technique that exploits and explores the optimum solution by combining the advantages of both WCA and MFO algorithms. In the PTS approach, we present an enhanced WCMFO to mitigate the higher PAPR of an OFDM system while reducing computing complexity.

WCA, MFO, PTS are now used and adapted in the construction of WCMFO-PTS. In the first, the WCA is altered by the MFO's helical movements. The WCMFO-PTS are then triggered by streams spiralling around the river and spiralling around the seas, providing an effective solution for the state space. In the second stage, to improve the suggested algorithm's detection capability, a random walk (Levy fly) is utilized to allow the flows' position to be updated, further increasing the randomness.

The suggested WCMFO-PTS algorithm's performance was evaluated using unimodal, stationary, and multimodal benchmarks effects in order to assess its efficiency and explore its capabilities. After that, the findings show that the suggested WCMFO-PTS algorithm outperforms the bulk of the benchmark problems and delivers very comparable, reliable data when compared with other methods.

Algorithm : The Proposed WCMFO- PTS

```
set the parameters of WCMFO such as Npop, Nsr, a, and maximum number of iterations
for i=1:Npop
Create a random stream
Calculate the objective function value of the stream
end for
sort the streams from best to worst based on their objective function value
Sea ← the first stream
Rivers ← sr n - 1
Stream ← pop n - sr n
Determine the intensity of flow for rivers and sea
i=0;
While i < maximum number of iterations
i=i+1;
for streams
Update the position of stream using spiral movement
Stream_objective=objective function value of the new stream
if stream_objective < river_objective
River_position= the new stream
if stream_objective < sea_objective
Sea_position= the new stream
end if
end if
if river_objective < sea_objective
Sea_position =River_position
end if
end for
for rivers
Update the position of rivers using spiral movement
river_objective =objective function value of the new river
if river_objective < sea_objective
Sea_position =River_position
end if
end for
for streams
Update the position of the streams using Levy flight
end for
for Rivers and streams
d=calculate the distance between each river or stream and the sea
if d < max d
raining process (for both rivers and streams)
end if
end for
Linearly decrease the parameter max d
Linearly decrease the parameter a
end while
Return the phase factor set with minimum PAPR as a solution
```

Figure1: Algorithm of proposed WCMFO-PTS.

When it comes to the WCA method, it has the benefit of being able to explore the optimum solution more thoroughly. The searching install their best fix positions as the rivers and streams available change their position relative to the sea. On the other hand, it lacks a competent operator who can perform manipulation. But from the other hand, the MFO method excels exploitation, thanks to its helical movement capability, but it is inefficient for exploring the optimum solution. This occurs when each moth adjusts its position in relation to its matching flame. As a result, the best possible solution data produced would not be distributed across the search agents.

The purpose of this research is to develop a safe, reliable and efficient combination of the WCA and MFO that really can profit from both method's advantages. In the suggested WCMFO-PTS algorithm, the WCA is regarded the fundamental algorithm. Use of such moths' indicates higher to update the location of streams and rivers is the first addition to the WCA. When adjusting the position of a stream, the fundamental WCA only analyses the distance in between a river and a stream. To put it differently, the stream's future location would be between streams and its corresponding river. The MFO system's update method, on either hand, permits moths to change their stance around their associated flame at any time. Updating stream and river locations with the moths spiral movement greatly improves the hybrid WCMFO-PTS's capacity to exploit.

RESULTS AND DISCUSSIONS

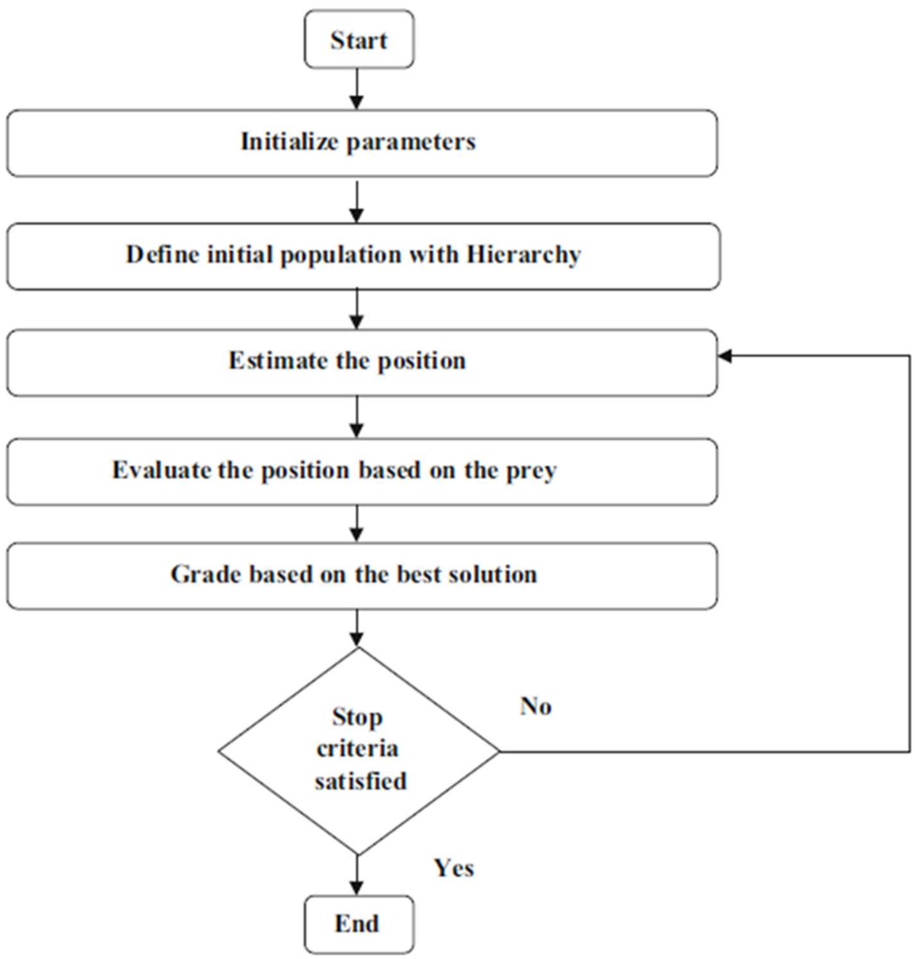

Figure2: Process flow of WCMFO

Different parameters are used to implement the suggested model and the calculation for OFDM is discussed in this part. To achieve the targeted results, the simulation is run in MATLAB-R2021a well with WCMFO optimization, which includes the PTS parameters. In an OFDM system and 100 usable sub-carriers, 32-PSK is employed for modulation. Then, the modulation being three to four times over-sampled, followed by the sub-carriers derivation from piloted sub-carriers and incremented for the duration of the simulation.

The presented model's efficiency is calculated employing factors such as CCDF of PAPR and the end results compared depending on computational effort in Figure3.

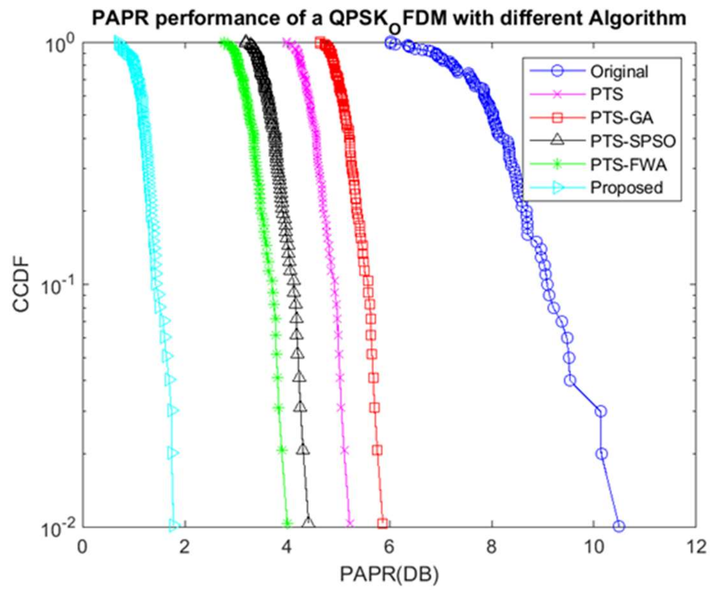

Figure3: PAPR comparison of different techniques.

Figure4 shows a MATLAB code of the WCMFO-PTS optimization technique to resolve the findings.

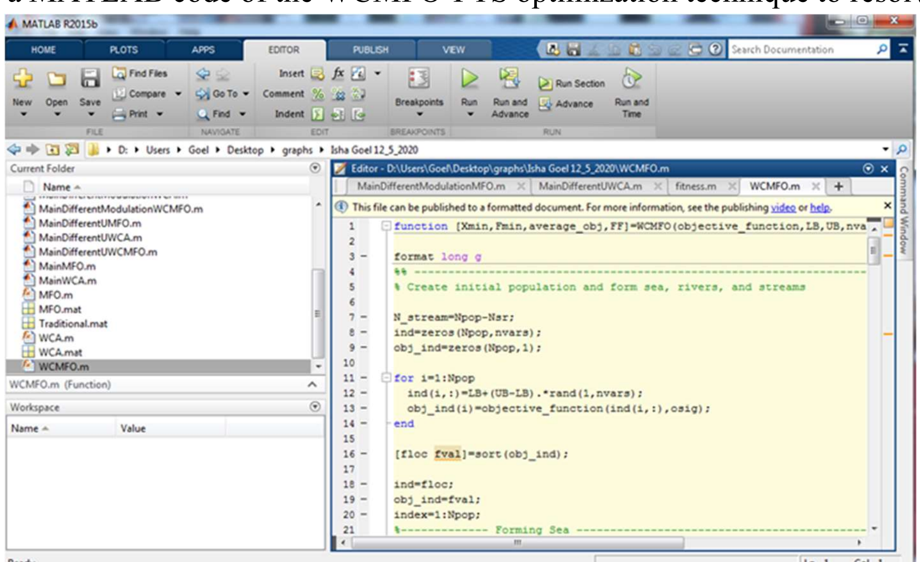

Figure4: MATLAB code of the WCMFO-PTS.

The simulation is carried very easily by setting the various parameters according to the research requirements. The results of the simulation are presented as a convergence graph. The suggested model is compared to several optimization strategies that are currently available for PAPR reduced. The suggested WCMFO-PTS optimization is compared to the results of the conventional OFDM system and its variations of PTS, PSO, SA-PSO, GWO, GWO-PTS, and WCMFO.

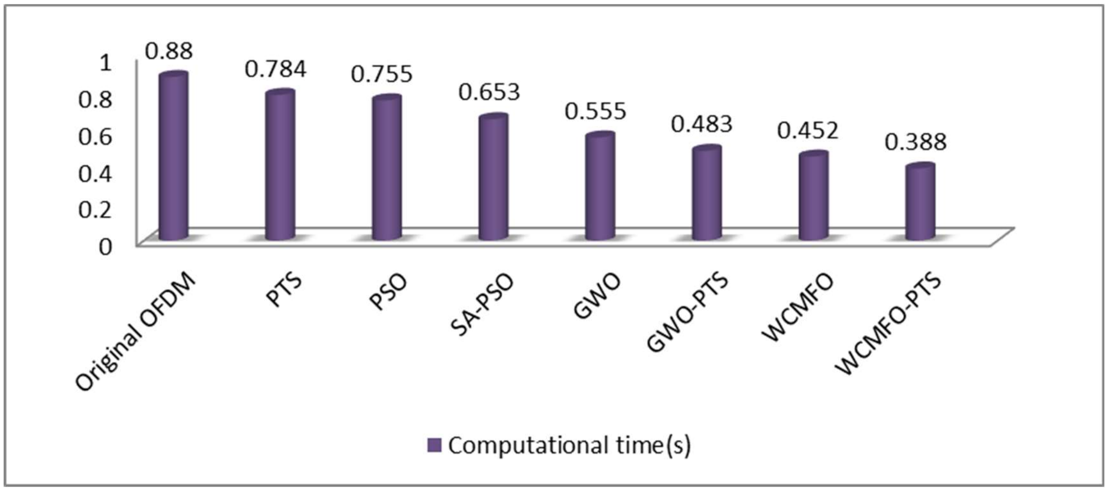

Figure5 : Proposed model's Computation complexity comparison.

V CONCLUSION

The Peak to Average Peak Ratio (PAPR) decrease and PTS method performance were investigated in this research. A single extensive search was also used to simulate the phase rotation parameters and to seek for the PTS. An adaptive WCMFO-PTS were developed to estimate the necessary optimal factor for a phase rotation while also supporting lesser complexity, in order to minimize the efficient detection complexity. Each component position is treated as a vector, and the multiplier to be used is specified as well. The suggested method is compared to other current techniques, and the suggested WCMFO-PTS's performance in respect of PAPR reduction is demonstrated. Furthermore, simulation findings show that the suggested strategy is a decent solution among PAPR reduction and computing complexity.

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